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USE OF LAKES AND RESERVOIRS BY MIGRATING SHOREBIRDS IN IDAHO

Daniel M. Taylor[1] and Charles H. Trost[1]

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Shorebirds migrating long distances are vulnerable because their wetland stopover sites are limited in number and susceptible to disturbance or destruction by humans (Senner and Howe 1984, Myers et al. 1987). It is therefore critical to know which wetland areas migrating shorebirds use, and the factors making these sites attractive to shorebirds.

We conducted shorebird censuses at numerous wetland sites in Idaho with these objectives: (1) to identify types of lakes and reservoirs that are important for migrating shorebirds, (2) to identify habitat characteristics at these wetlands used by shorebirds, (3) to determine the influence of mudflat exposure and water level changes on shorebird use.

Study Areas and Methods

A total of 19 lakes and reservoirs were censused at least once in 1989 (Table 1). Nine high-elevation lakes were visited in the Sawtooth Wilderness in early September 1976, and three high-elevation lakes in the Seafoam area of the Frank Church River of No Return Wilderness in early August 1990. Additional observations from Lake Lowell were made in 1986, 1987, and 1990. All shorebirds were censused within 100 m of the shoreline in and out of the water at all sites; thus, every 500 m of transect censused was equal to 0.1 km^2. We estimated birds per 500 m of shoreline for our density estimates. The Springfield area of American Falls Reservoir had over 15 km of mudflat exposed by drawdown during the study period and also included numerous seep areas away from the main shoreline; because of this, it was not possible to make density estimates from this site. Four of the lakes and reservoirs visited in 1989 had mudflat areas that were censused at least six times at roughly weekly intervals from mid-July to early September, the time of peak shorebird abundance in Idaho (Taylor et al. 1992). We used ANOVA and Newman-Keuls tests (Zar 1974) to compare differences in shorebird numbers at these four sites. Birds were censused by walking from 10 to 100 m back from the shoreline and using binoculars and a 25X spotting scope. Care was taken not to disturb birds. If birds moved, their numbers were kept track of, or the entire count was restarted to avoid counting birds more than once.

Results

The natural lakes at high elevations we censused in 1989 (Table 2) had only 0–2 Spotted Sandpipers (see Table 3 for all scientific names). Only a single Spotted Sandpiper was found at nine high-elevation lakes visited in the Sawtooth Wilderness in September 1976. No shorebirds were found at three high-elevation lakes in the Seafoam area in early August 1990.

At the Lowell, Walcott, American Falls, and Carey areas we found significant differences in the densities of total shorebirds (ANOVA, $F_{2(3)26} = 88.76$, $P < .001$). Lake Lowell had significantly the most shorebirds, American Falls had significantly more than Carey Lake, but Carey Lake's higher mean was not significantly more than Lake Walcott's (Newman-Keuls, $q = 29.89$ to 7.47, for significant differences $P < .05$ or greater; $q = 2.04$, $P = .2$ for Carey Lake–Lake Walcott). These differences in shorebird numbers reflect the amount of mudflat available at the different sites; the larger the mudflats, the greater the number of shorebirds.

The pattern of more shorebirds being attracted to larger mudflats is further supported by shorebird numbers at different Lowell sites

[1]Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209

TABLE 1. Characteristics of Idaho lakes and reservoirs surveyed for shorebirds in 1989.

Name	County	Elevation (m)	Transect length (m)	Habitat
Reservoirs and lakes with mudflats				
American Falls	Power	1321	900	500 m mudflat
Lowell	Canyon	757	4600	1200 m mudflat
Walcott	Minidoka	1279	1500	20 m mudflat
Carey	Blaine	1453	2200	200 m mudflat
Little Camas	Elmore	1502	800	120 m mudflat
Dry	Canyon	818	1500	50 m mudflat/700 m grass
Mackay	Custer	1849	1400	200 m mudflat
Palisades	Bonneville	1708	1600	1000 m mudflat
Reservoirs and lakes without mudflats				
Cascade	Valley	1472	2600	1–2 m sandy or muddy shore
Wilson	Jerome	1224	1800	dirt or grass shore
Boulder	Valley	2127	900	2 m mud or rocky shore
Brmeau	Owyhee	763	2300	1 m mud or sandy shore
High-elevation lakes				
Alice	Blaine	2622	1000	herb or rocky shore
Toxaway	Custer	2539	900	herb or rocky shore
Edith	Custer	2611	600	herb or rocky shore
East	Valley	2373	1100	herb or rocky shore
West	Valley	2361	900	herb or rocky shore
North	Valley	2367	700	herb or rocky shore
Payette	Valley	1522	700	herb or rocky shore

responding to changes in mudflat conditions in 1989 (Fig. 1). In July Public Access No. 1 had very few shorebirds, and nearly all of its mudflats were submerged by water (Fig. 1b). The New York Canal site was submerged at this time and had no birds (Fig. 1a). When the large mudflats of the New York Canal site became exposed in August, thousands of shorebirds appeared there (Fig. 1a). Numbers of shorebirds at some of the other sites declined (Fig. 1b), which may have been due in part to birds shifting to the New York Canal site. The reflooding of Lowell in late September 1989 completely eliminated shorebirds from census areas by 27 September (Fig. 1), although American Falls Reservoir had over 500 shorebirds at this time. On 27 September 1990, with Lake Lowell very low due to dam reconstruction, there were extensive mudflats at the New York Canal site, and 926 individuals of 10 species of shorebirds were present. In early July 1986 there were hundreds of shorebirds on the exposed mudflats at Public Access No. 1, but in early July 1987, with high water flooding into riparian vegetation at this site, there were no shorebirds.

The reservoirs we counted once or a few times in 1989 usually supported the pattern of total shorebird numbers declining with decreasing mudflat size, but there were some exceptions (Table 2). Wilson, Boulder, and Cascade reservoirs all had zero or only a few meters of exposed shoreline, and they had only 1 or 2 shorebirds. Mackay Reservoir had only 2 shorebirds on 3 July when no mudflats were exposed, but 351 two weeks later when there was 200 m of mudflat. The Dry and Little Camas reservoirs supported hundreds of shorebirds (Table 2), and these sites had mudflats of 50–120 m. However, Brmeau had only 1–2 m of mud or sandy beach, and it had 79 individual shorebirds. An even stronger anomaly was Palisades, a reservoir which had exposed mudflats of about 1000 m and water drawdown continually exposing new areas, but practically no birds (Table 2).

Black-bellied Plovers, Lesser Golden-Plovers, Sanderlings, Pectoral Sandpipers, and Stilt Sandpipers were found only on mudflats with >500 m of exposed mud (Table 3). Ten other shorebirds species were most abundant at sites with >500 m of exposed mudflat. Eight shorebird species had similar-sized peaks at sites with >500 m or between 20 and 200 m of exposed mudflat. The only species with a maximum peak on mudflats between 20 and 200 m was the uncommon Long-billed Curlew. No individual shorebird species had maximum numbers at

TABLE 2. Total number and, in parentheses, density per 0.5 km of transect of shorebirds counted at lakes and reservoirs in Idaho in 1989.

Count area	N	Mean	SD	Range
Springfield	9	2296	578.1	1698–3252
American Falls	9	209	87.2	92–337
		(105)	(43.6)	(46–168.5)
Lowell	8	3061	1839.6	752–5739
		(323)	(230.6)	(78–717)
Walcott	9	54	40.6	17–153
		(18)	(13.4)	(6–50)
Carey	6	254	111.9	80–393
		(58)	(25.4)	(18–89)
Little Camas	4	294	161.5	117–446
		(184)	(101.0)	(73–279)
Dry	4	132	28	93–158
		(44)	(9.3)	(31–53)
Mackay	2	177		2–351
		(62)		(1–125)
Palisades	4	18	23.6	0–70
		(6)	(8.3)	(0–18)
Cascade	2	0		
Boulder	1	1		
		(0.6)		
Wilson	1	0		
Bruneau	1	79		
		(17)		
Alice	1	1		
		(1)		
Payette	1	0		
Edith	1	0		
Toxaway	1	1		
		(0.7)		
West	1	0		
East	1	0		
North	1	0		

sites with <5 m of mudflats or rocky/herb shorelines.

DISCUSSION

The virtual absence of shorebirds from the 19 high-elevation lakes we visited in 1976, 1989, and 1990 is similar to the findings of the only previous study of a high-elevation lake in Idaho. Visits annually to Fish Lake, Idaho Co., from 1923 to 1929 found only a few Solitary Sandpipers and Spotted Sandpipers, and one or two individuals of four other species (Hand 1932). Burleigh (1972) reported no large numbers of shorebirds at any high-elevation lakes in Idaho. Further investigation may reveal some high-elevation lakes to be important for migrating shorebirds, but the lack of mudflats at most of these lakes probably limits their use by most shorebird species.

The concentration of most shorebirds at large mudflats is consistent with our previous findings at American Falls Reservoir, where we found very few shorebirds on sandy, clay, or boulder beaches or bedrock (Taylor et al., unpublished data). Shorebirds also concentrated on mudflats at inland studies done in Nevada (Hainline 1974), Missouri (Rundle and Fredrickson 1981), and Saskatchewan (Colwell and Oring 1988), although the latter study also had some shorebird species associated with different habitats. Our study also shows that small and moderate-sized mudflats of both natural lakes and reservoirs may attract some shorebirds, especially those that often feed in water.

Shorebird species that primarily or completely feed by probing in or gleaning off land surfaces or very shallow water almost always had higher peaks on the larger mudflats, or were found there exclusively. An exception was Baird's Sandpiper, which had a similar peak between large and moderate mudflats. Five of the shorebird species with equal-sized peaks on large and moderate mudflats, the Black-necked

TABLE 3. Shorebird species found at 19 reservoirs and lakes in Idaho in 1989.

Species	Abundance[a] and habitat use[b]
Black-bellied Plover *Pluvialis squatarola*	Uncommon on large mudflats.
Lesser Golden-Plover *Pluvialis dominica*	Rare on large mudflats.
Semipalmated Plover *Charadrius semipalmatus*	Uncommon on large mudflats; rare on moderate mudflats and muddy shores.
Killdeer *Charadrius vociferus*	Common on large and moderate mudflats; uncommon on muddy shores; occasional on rocky/herb shoreline.
Black-necked Stilt *Himantopus mexicanus*	Uncommon on large and moderate mudflats; rare on muddy shores.
American Avocet *Recurvirostra americana*	Abundant on large mudflats; uncommon on moderate mudflats and muddy shores.
Greater Yellowlegs *Tringa melanoleuca*	Uncommon on large and moderate mudflats; occasional on muddy shores.
Lesser Yellowlegs *Tringa flavipes*	Common on large mudflats; uncommon on moderate mudflats; occasional on muddy shorelines.
Solitary Sandpiper *Tringa solitaria*	Occasional to rare on all shore types.
Willet *Catoptrophorus semipalmatus*	Uncommon on large mudflats; occasional on moderate mudflats; rare on muddy shorelines.
Spotted Sandpiper *Actitis macularia*	Uncommon on large and moderate mudflats, muddy shorelines; occasional on rocky/herb shorelines.
Long-billed Curlew *Numenius americanus*	Occasional on moderate mudflats; rare on large mudflats.
Marbled Godwit *Limosa fedoa*	Common on large mudflats; occasional on moderate mudflats.
Sanderling *Calidris alba*	Uncommon on large mudflats.
Semipalmated Sandpiper *Calidris pusilla*	Uncommon on large mudflats; occasional on moderate mudflats.
Western Sandpiper *Calidris mauri*	Abundant on large mudflats; common on moderate mudflats; uncommon on muddy shores.
Least Sandpiper *Calidris minutilla*	Uncommon on large mudflats; occasional on moderate mudflats.
Baird's Sandpiper *Calidris bairdii*	Common on large and moderate mudflats; occasional on muddy shores.
Pectoral Sandpiper *Calidris melanotus*	Uncommon on large mudflats.
Stilt Sandpiper *Calidris himantopus*	Rare on large mudflats.
Short-billed Dowitcher *Limnodromus griseus*	Occasional on large and moderate mudflats.
Long-billed Dowitcher *Limnodromus scolopaceus*	Common on large mudflats; uncommon on moderate mudflats and muddy shores.
Common Snipe *Gallinago gallinago*	Uncommon on large mudflats; occasional on moderate mudflats and muddy shores.
Wilson's Phalarope *Phalaropus tricolor*	Common on large and moderate mudflats; uncommon on muddy shores.
Red-necked Phalarope *Phalaropus lobatus*	Common on large and moderate mudflats; occasional on muddy shores.

[a]A species was considered abundant if it had a single peak count over 1000 at a specific site, common with a peak over 100, uncommon with a peak over 10, occasional with a peak under 10, and rare if only one or two individuals were found.
[b]Large mudflats include American Falls, Springfield, Palisades, and Lowell, and all had water drawdown exposing mudflats of distances >500 m. Moderate mudflats include Carey, Little Camas, Dry (in part), Mackay, and Walcott, and had water drawdown exposing 20–200 m of mudflat. Muddy shores included Dry (in part), Brunean, Cascade, Boulder, and Payette (in part), and these included small muddy shorelines or mudflats of 5 m width or less and also sandy or dirt shorelines. Rocky/herb shorelines included Alice, Dry (in part), East, Edith, North, Payette (in part), Toxaway, and Wilson

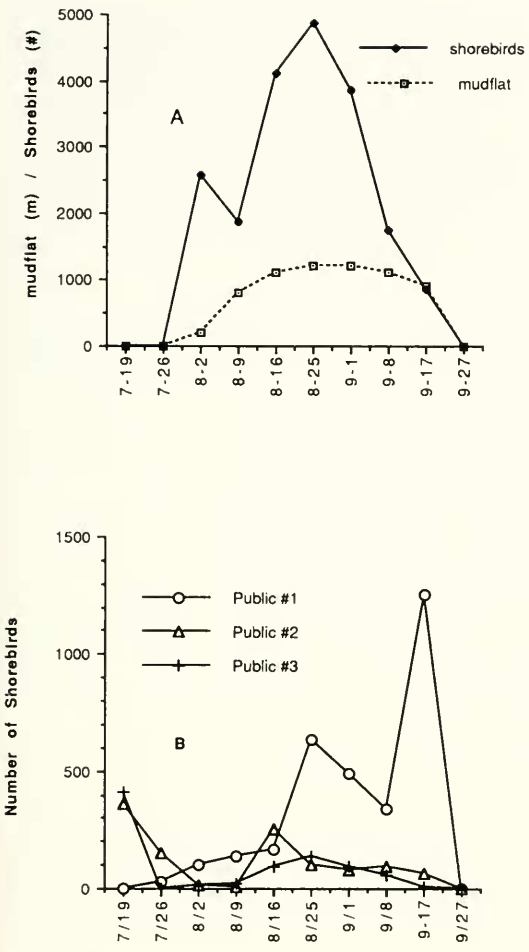

Fig. 1. Weekly counts of the total number of shorebirds at four sites at Lake Lowell, Canyon Co., Idaho, in 1989. (A) New York Canal Mouth site, with both total number of shorebirds and the amount of mudflat exposed. (B) Open circle is Public Access No. 1 site; open triangle is Public Access No. 2 site; vertical line is Public Access No. 3.

Stilt, Greater Yellowlegs, Short-billed Dowitcher, Wilson's Phalarope, and Red-necked Phalarope, along with the Long-billed Curlew, all often feed in water. The two remaining species with similar-sized peaks between large and moderate mudflats, the Killdeer and Spotted Sandpiper, were the most widespread.

This study indicates that most reservoirs and lakes in Idaho and the Intermountain West can provide habitat for shorebirds in fall migration if they have moderate to large mudflats that can be exposed by water drawdown during summer and fall. The absence of shorebirds at some reservoirs with large mudflats, in particular Palisades Reservoir in this study, indicates there are additional factors influencing shorebird use. This could include food abundance (Harrison 1982, Myers et al. 1987), which is important at American Falls Reservoir (Miluc 1991), traditional use (Myers et al. 1987), and in the case of Palisades Reservoir possible difficulty of shorebirds locating it because it is enclosed by high mountains in all directions (personal observation). Steep-sided reservoirs, such as C. J. Strike, Hell's Canyon (personal observation), and Lower Granite Creek (Monda and Reichel 1989) on the Snake River, and stretches of the Columbia River subject to water level fluctuations (Books 1985), supported few shorebirds even with water drawdown in summer and fall.

The absence of shorebirds at Lake Lowell and Mackay Reservoir from sites when high water covered mudflats shows the importance of water drawdown exposing these areas during migration. At American Falls Reservoir we have previously found shorebird numbers to be correlated with rate of drawdown (Taylor et al., unpublished data). Water levels at reservoirs in this region are usually determined by irrigation, power generation, recreational activities such as boating, or waterfowl management. It is important that controllers of water levels at reservoirs and lakes (1) become aware of the potential or real use of shorebirds in their area and (2) manage water levels for shorebirds whenever feasible.

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